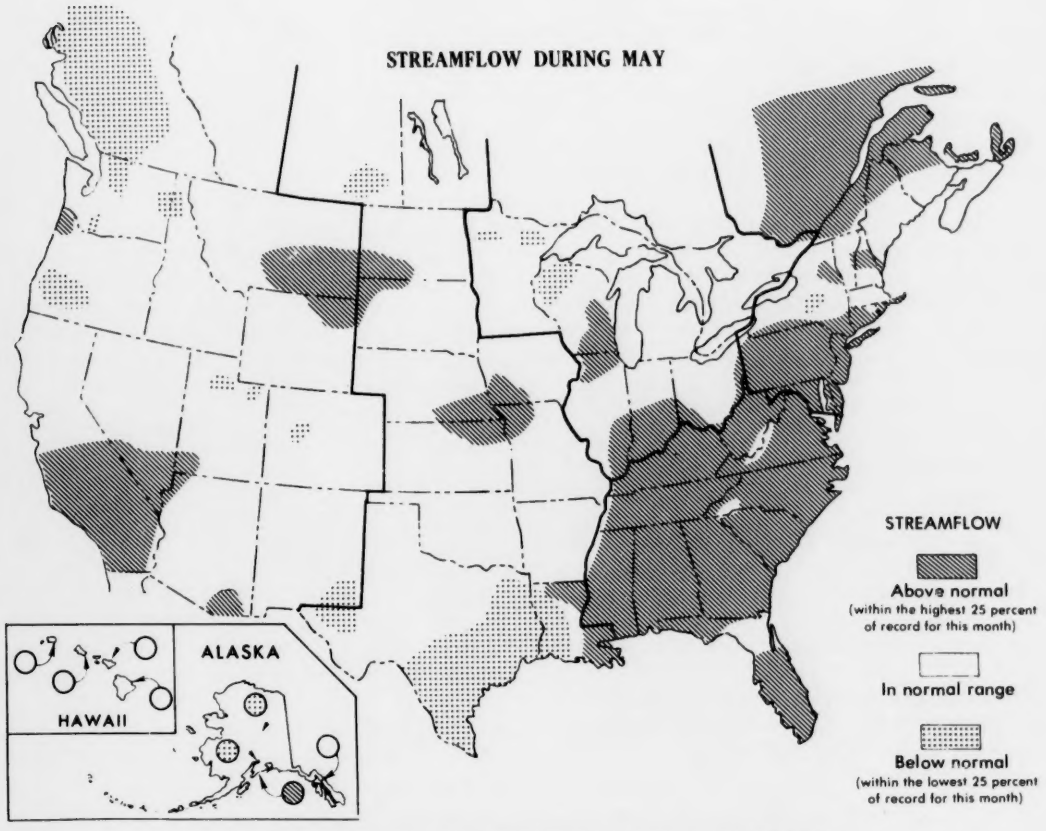
WATER RESOURCES REVIEW for MAY 1978

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

CANADA
DEPARTMENT OF THE ENVIRONMENT
WATER RESOURCES BRANCH



STREAMFLOW AND GROUND-WATER CONDITIONS

Streamflow generally decreased seasonally in most north-central and northeastern States, was variable in the southwestern part of the conterminous 48 States, and generally increased elsewhere, including southern Canada, Alaska, and Hawaii.

Severe flooding occurred along the Yellowstone River and its tributaries in southeastern Montana and northeastern Wyoming. Flooding was also reported in Indiana, Iowa, Kansas, Kentucky, Louisiana, Mississippi, Missouri, North Carolina, Oklahoma, Texas, Virginia, and Wisconsin.

Above-normal streamflow persisted in southern Nevada and parts of adjacent States and increased into that range in the Southeast Region, southeastern Canada, and in parts of many north-central and northeastern States. Monthly and daily mean flows were highest of record for May in Quebec, Connecticut, Florida, Maryland, Mississippi, North Carolina, New York, and West Virginia.

Ground-water levels declined in the northern part of the Northeast Region, but rose in the southern part. Although trends were regionally mixed in the Southeast and Western Great Lakes Regions, levels generally rose and were above average in Kentucky, Virginia, North Carolina, and Indiana, declined and were below average in Mississippi, and declined but were above average in Ohio. Trends and conditions with respect to average were regionally mixed also in the Mid-continent and in the West.

New high levels for May were recorded in Arizona, Connecticut, and Pennsylvania, and new lows for May in Arizona, Arkansas, Georgia, Idaho, Kansas, Louisiana, Mississippi, and Tennessee. New alltime highs were reached in California and Nevada, and new alltime lows occurred in Idaho and Texas.

NORTHEAST

[Atlantic Provinces and Quebec; Delaware, Maryland, New Jersey, New York, Pennsylvania, and the New England States]

Streamflow generally increased in Maryland, New Hampshire, and Quebec, decreased in Massachusetts, Rhode Island, and Vermont, and was variable elsewhere in the region. Monthly mean flows remained in the above-normal range in Rhode Island and increased into that range in parts of most States and Provinces. Snowmelt runoff was gradual in Quebec and in most northern States in the region and did not cause significant flooding. Flows decreased into the below-normal range in parts of New York. Monthly and/or daily mean flows were highest of record for the month in parts of Quebec, Connecticut, Maryland, and New York.

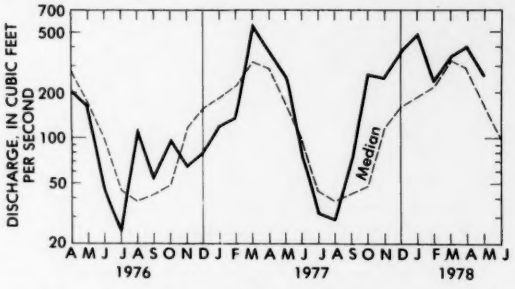
Ground-water levels declined in most of the northern parts of the region, and rose in most of Pennsylvania and Maryland. Levels were again above average in many areas--the highest end-of-May levels in more than thirty years in some wells in Connecticut and Pennsylvania.

In the Matane River basin in southeastern Quebec, where mean flow was below the normal range and only 36 percent of median in April, flow increased sharply during May as a result of snowmelt runoff and the monthly mean discharge of 9,470 cfs at Matane (drainage area, 636 square miles) was highest for any month in 56 years of record. Elsewhere in Quebec, streamflow generally increased seasonally and was above the normal range, but, as a result of a gradual melting of the near record high snowpack, no serious flooding occurred.

In northern parts of the Atlantic Provinces, streamflow increased seasonally and was above the normal range. For example, in northern New Brunswick, monthly mean flow at Upsalquitch River at Upsalquitch increased sharply to 156 percent of median and into the above-normal range. Similarly, in northern Nova Scotia, in Northeast Margaree River at Margaree Valley, where mean flow was below the normal range and only 60 percent of median in April, flow increased sharply to 174 percent of median and was only 50 cfs less than the record high monthly mean flow of 2,810 cfs that occurred in 1923. Elsewhere in the Provinces, mean flows decreased seasonally and were in the normal range.

In northern Maine, streamflow increased seasonally in St. John River below Fish River, at Fort Kent and was in the above-normal range at 150 percent of median. Elsewhere in the State, mean flows decreased seasonally, were above median, and in the normal range.

In central New Hampshire, mean flow in Pemigewasset River at Plymouth was 29 percent more than the mean flow in April, in contrast to the normal seasonal decrease of 22 percent at that site and was above the normal range in May. Elsewhere in the New England States, streamflow generally decreased seasonally and was in the normal range except at Branch River at Forestdale, Rhode Island, where monthly mean flow remained above median for the 9th consecutive month and was above the normal range. (See graph.)



Monthly mean discharge of Branch River at Forestdale, R.I. (Drainage area, 91.2 sq mi; 236.2 sq km)

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In Salmon River basin, in southeastern Connecticut, flow at the index station near East Hampton (drainage area, 102 square miles) increased sharply near month-end. The monthly mean discharge of 408 cfs and the daily mean of 1,600 cfs on the 25th were highest for the month in 49 years of record. In the western part of the State, mean flows in Burlington Brook near Burlington and Pomperaug River at Southbury also increased and were above the normal range.

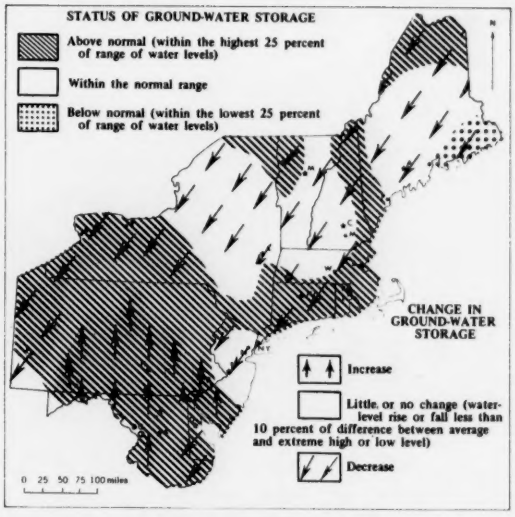
In south-central New York, monthly mean discharge in Susquehanna River at Conklin decreased sharply and was below the normal range for the first time since June 1977. In the northeastern part of the State, the seasonal decrease in flow in Hudson River at Hadley was less than normal and mean flow at that site was in the above-normal range. Also, on Long Island, the daily mean discharge of 56 cfs on the 24th at Massapequa Creek at Massapequa (drainage area, about 38 square miles) was highest for May in record that began in 1936 and the monthly mean discharge at that site was above the normal range.

In New Jersey, where streamflow during April was in the normal range and slightly greater than median, mean flows generally increased at the index stations during May and were above the normal range as a result of above-normal precipitation.

In Pennsylvania, mean flows increased at some index stations and decreased at others but flows at all sites were above the normal range. For example, in the northwestern part of the State, the seasonal decrease in streamflow in Oil Creek at Rouseville was less than normal and the resulting monthly mean flow was above the normal range. Precipitation in all river basins in the State was above normal.

In the Choptank River basin in eastern Maryland and the adjacent area of Delaware, monthly mean flow at the index station near Greensboro, Md. was over 2 times the median flow and above the normal range. In central Maryland, the daily mean discharge of 1,470 cfs on the 16th at Seneca Creek at Dawsonville, Md. (drainage area, 101 square miles) was highest for May in 48 years of record. Flow of Potomac River near Washington, D.C. (drainage area, 11,560 square miles) increased sharply as a result of heavy rains near midmonth and the resulting monthly mean discharge of 31,390 cfs was highest for the month in record that began in March 1930.

Ground-water levels declined seasonally in most of New England, New York, and northern New Jersey. (See map.) Levels rose in most of Pennsylvania, Maryland, and southern New Jersey. Levels were again above average in many parts of the region, including most of Rhode Island. Connecticut, Pennsylvania, Delaware, Maryland, and western New York State. Levels near end of May in some wells in Connecticut and Pennsylvania were highest for that month in more than thirty years of record. Levels were below average in easternmost Maine.


STATUS OF GROUND-WATER STORAGE
Above normal (within the highest 25 percent of range of water levels)
Within the normal range
Below normal (within the lowest 25 percent of range of water levels)
N
CHANGE IN GROUND-WATER STORAGE
Increase
Little or no change (water-level rise or fall less than 10 percent of difference between average and extreme high or low level)
Decrease
0 25 50 75 100 miles

Map shows ground-water storage near end of May and change in ground-water storage from end of April to end of May.

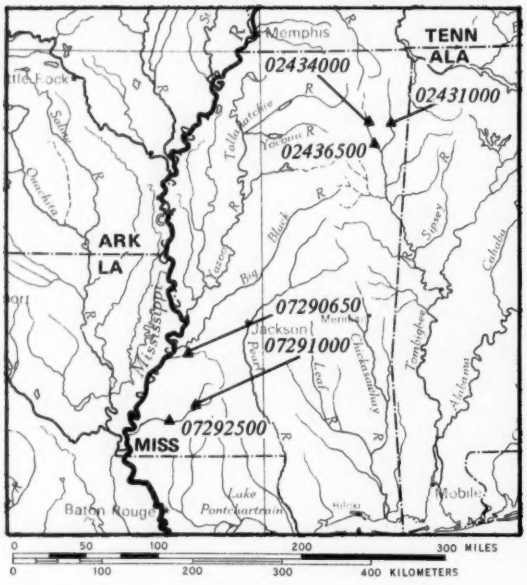
SOUTHEAST

[Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee, Virginia, and West Virginia]

Streamflow increased, contrary to the normal seasonal pattern of decreasing flows, at all index stations in the region except one. Monthly mean discharges were in the above-normal range at all stations except three, and were highest of record for May in parts of Florida, North Carolina, and West Virginia. Flooding occurred in Mississippi, Kentucky, North Carolina, and Virginia.

Ground-water levels generally rose and were above average in Virginia, Kentucky, North Carolina, and Alabama, and declined in Tennessee; conditions were mixed elsewhere in the region. New lows for May occurred in Tennessee, Mississippi, and Georgia.

In southwestern Mississippi, runoff from reported rainfall of as much as 8 inches resulted in flooding in the Homochitto River basin May 7, and in the extreme northeastern corner of the State, runoff from 5 to 6 inches of rainfall resulted in flooding in Mobile River basin on May 8. Selected data on stages, discharges, recurrence intervals, and gaging station locations are given in the accompanying map and table on page 4.



Location of stream-gaging stations in Mississippi, described in table at peak stages and discharges.

The monthly mean discharge of 18,720 cfs in Tombigbee River at Columbus (drainage area, 4,490 square miles), in northeastern Mississippi, was highest for May in 63 years of record and was 431 percent of the May median flow, representing an increase over the observed April mean flow of 685 percent, in contrast to the normal seasonal decrease of 60 percent in the reference-period median discharges from April to May. In the central part of the State, monthly mean discharge in Big Black River near Bovina also increased contrary to the normal seasonal pattern of decreasing flow. (See graph on page 5.)

In Kentucky, where May mean and median flows normally are less than those for April, monthly mean flows increased sharply from less than ½ median and below the normal range in April, to about 4 times median and above the normal range in May. For example, mean flow in Licking River at Catawba, in south-central Kentucky, increased from 41 percent of median in April to 373 percent of the median for May. Some minor flooding occurred as a result of severe thunderstorms.

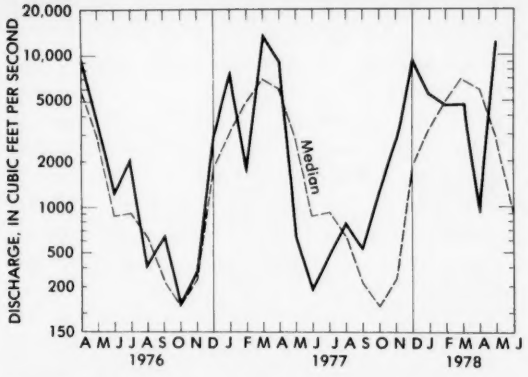
In North Carolina, minor flooding that was in progress at the end of April along the larger streams in the eastern

Provisional data; subject to revision

FLOOD DATA FOR SELECTED SITES IN MISSISSIPPI, MAY 1978

WRD station number	Stream and place of determination	Drainage area (square miles)	Period of known floods	Maximum flood previously known			Maximum during present flood				
				Date	Stage (feet)	Discharge (cfs)	Date	Stage (feet)	Discharge		Recurrence interval (years)
									Cfs	Cfs per square mile	
	MISSISSIPPI										
	MOBILE RIVER BASIN										
02431000	Tombigbee River near Fulton	612	1928–	Mar. 22, 1955	25.75	82,200	May 8	20.18	33,000	54	10
02434000	Town Creek at Eason Boulevard at Tupelo	230	1970–	Mar. 16, 1973	27.05	22,400	8	27.08	23,000	100	<10
02436500	Town Creek near Nettleton	617	1939–	Mar. 22, 1955	33.88	151,000	8	[a]30	41,000	66	5
	BAYOU PIERRE BASIN										
07290650	Bayou Pierre near Willows	653	1959–	Apr. 13, 1974	[b]27.33	51,000	8	26.33	38,000	58	25
	HOMOCHITTO RIVER BASIN										
07291000	Homochitto River at Eddiceton	180	1938–	Apr. 13, 1974	19.53	55,400	7	[a]18	41,000	228	25
07292500	Homochitto River at Rosetta	750	1906, 1949–	Apr. 13, 1974	[c]28.60	150,000	7	21.50	65,000	87	7

[a] About.
[b] Maximum gage height 27.42 ft, Oct. 5, 1964.
[c] Maximum gage height 37.80 ft, Mar. 31, 1949.



Monthly mean discharge of Big Black River near Bovina, Miss. (Drainage area, 2,810 sq mi; 7,280 sq km)

Piedmont and Coastal Plain continued into May. This high carryover flow resulted in a monthly mean discharge of 3,781 cfs in Neuse River near Clayton (drainage area, 1,140 square miles), highest for the month since records began in July 1927, and 5½ times the median flow for May. In the adjacent basin of Cape Fear River, mean flow at William O. Huske Lock near Tarheel increased 95 percent from April to May, in contrast to the normal seasonal decrease of 46 percent in median discharge. In the central part of the State, rapid runoff from reported rainfall amounts of 3½ inches May 4–5 and 2 inches May 8 resulted in peak discharges with recurrence intervals of about 3 to 12 years, and some overbank flooding of cropland. In the Tennessee River basin in western North Carolina, mean flow in French Broad River at Asheville also increased, contrary to the usual seasonal pattern, was 131 percent of median, and was in the normal range.

In South Carolina, monthly mean flows also increased in contrast to the normal seasonal pattern of decreasing flows, were in the above-normal range, and were 2 to 3 times the median flows for May.

In Tennessee, where monthly mean flows at all index stations were in the below-normal range and about 1/3 of median in April, and where normal May flows are less than those of April, flows increased unseasonally, were 1½ to about 4 times the May median flows, and were in the above-normal range. For example, in Cumberland River basin in north-central Tennessee, mean flow in Harpeth River near Kingston Springs increased from about 1/3 median in April to nearly 4 times median in May, in contrast to the normal seasonal decrease of 50 percent in median flow from April to May.

Similarly, in northern Alabama, where the reference-period monthly median and mean flows for May are less than those for April, and where observed April mean flows were below the normal range and about 1/3 of median, flows increased sharply and were 2 to about 3½ times the medians for May and were above the normal range. For example, mean flow in Tombigbee River at Demopolis lock and dam, near Coatopa, was 329 percent greater than the April mean flow at that site, in contrast to the normal seasonal decrease of 57 percent in median flow from April to May.

In Georgia, monthly mean flows increased at all index stations in contrast to the normal seasonal decrease. In the east-central part of the State, mean flow in Altamaha River at Doctortown was 59 percent greater than that in April, contrary to the normal seasonal decrease of 50 percent. In extreme southern Georgia, mean flow in Alapaha River at Statenville increased 44 percent, in contrast to the normal seasonal decrease of 63 percent in the median discharge, and in the extreme northern part of the State, where the normal, or median, discharge in Oconee River near Greensboro decreases from 1,898 cfs in April to 1,215 cfs in May, the observed monthly mean flow increased from 1,219 cfs in April to 1,601 cfs in May. Flows were in the above-normal range at all index stations.

In the Apalachicola River basin, in northwestern Florida and the adjacent areas of Alabama and Georgia, monthly mean flow at the index station at Chattahoochee, Fla., increased sharply, contrary to the normal seasonal pattern of decreasing flows, and was in the above-normal range. Also in northwestern Florida and the adjacent area of Alabama, flow in Shoal River near Crestview, Fla. (drainage area, 474 square miles) increased, in contrast to the normal seasonal pattern of decreasing monthly mean flow, remained above the normal range for the 6th time in the past 7 months, and the monthly mean discharge of 2,710 cfs was highest for May since records began in July 1938. In west-central Florida, mean discharge in Peace River at Arcadia increased sharply, contrary to the normal seasonal pattern of decreasing flow, was 2 times the May median discharge and was in the above-normal range. In extreme southwestern Florida, mean flow in Fisheating Creek at Palmdale increased, contrary to the normal seasonal pattern of decreasing flow, and was about 10 times the median discharge for May. In Tamiami canal outlets, 40-mile bend to Monroe, where mean flows in March and April were 80 times and 62 times the respective medians for those months, monthly mean discharge in May was 28 times median for the month.

In southeastern West Virginia, where mean flow in Greenbrier River at Alderson was only ½ of median and below the normal range in April, increased runoff from rains near midmonth resulted in monthly mean discharge in May that was well above median and within the

normal range. In the extreme northern part of the State, flow in Potomac River at Paw Paw (drainage area, 3,109 square miles) also increased sharply near midmonth and the monthly mean discharge of 8,582 cfs was highest for the month since records began in October 1938. These increased flows were contrary to the normal pattern of decreasing monthly mean discharge from April to May.

In Virginia, mean flows at all index stations were higher in May than in April, in contrast to the established pattern of decreasing mean and median flows from April to May throughout the State. For example, mean flow in Rapidan River near Culpeper, in the northern part of the State, was 105 percent greater than in April in contrast to the reference-period median flow which is 17 percent less for May than for April. In the extreme western part of the State, mean flow in Nottaway River near Stony Creek increased 9 percent from April to May in contrast to the seasonal pattern of decreasing reference-period mean and median flows. Runoff from intense rainfall in this basin during the last week in April, augmented by additional runoff from heavy rains during the first week in May resulted in a peak discharge of 4,960 cfs on May 6 at the Stony Creek index station (drainage area, 579 square miles) which is equivalent to that of a 2-year flood at that site. Similar flooding occurred also in other parts of the State.

Ground-water levels in West Virginia declined in the northern and eastern panhandles, remained about the same in the southern half of the State, and rose elsewhere. Levels were above and below average statewide. In Kentucky, levels rose and were above average in most areas, except where affected by heavy pumping. In Virginia, levels rose in response to above-average precipitation. Levels were above average in all three key wells--that in the Tyler well in Louisa County was above average for the first time since February 1977. In western Tennessee, the artesian level in the key well in the "500-foot sand" near Memphis declined slightly and was at a new low for May; the level continued more than 15 feet below average. In North Carolina, levels rose in most areas and were slightly above average. In Mississippi, levels generally declined, although slight rises occurred in wells screened in the Sparta Sand in the Jackson area; levels in the Sparta were considerably below those of a year ago. Declining levels continued in wells screened in the Gordo and Eutaw Formations, in the Tupelo and West Point areas in the northeastern part of the State; levels in some wells reached new lows for May. In Alabama, levels generally rose and were above average. In Georgia, levels in the coastal counties declined in the principal artesian aquifer. In the Savannah area, the level in the Cockspur Island well rose slightly but was nearly 7 feet below average and at a new low for May in 22 years of record. Levels in southwestern Georgia declined 1 to 3 feet but ranged up to 10 feet higher than a year ago. Levels generally declined in northern Florida but rose in much of the central peninsular part of the State. In southeastern Florida, levels declined and were below average in Palm Beach and Broward Counties, and rose and were above average in most of Dade County.

WESTERN GREAT LAKES REGION

[Ontario; Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin]

Streamflow decreased seasonally except in parts of Ontario, where seasonal increases occurred, and in parts of Ohio, Indiana, Illinois, and Wisconsin, where flows increased in contrast to the normal seasonal pattern of decreasing flows. Monthly mean flows remained in the above-normal range in parts of Ohio and Indiana, and decreased into the below-normal range in parts of Wisconsin. Minor flooding occurred in Indiana and Wisconsin.

Ground-water levels rose in Illinois and Indiana, declined in Ohio, and showed mixed trends elsewhere. Levels were average or above average in Illinois, Indiana, and Ohio, above and below average in Minnesota, and below average in Michigan.

In Indiana, minor flooding of low-lying agricultural land occurred near midmonth as a result of runoff from intense thunderstorm rainfall. Monthly mean flow increased in East Fork White River at Shoals, in southeastern Indiana, in contrast to the normal seasonal pattern of decreasing flow, was 2½ times the median for May, and was above the normal range. In the western part of the State, and the adjacent area of eastern Illinois, mean flow in Wabash River, as measured at Mt. Carmel, Ill., decreased seasonally but remained above the normal range for the 3d consecutive month as a result of high carryover flow from April, augmented by runoff from rains in the last half of the month.

In northern and southern parts of Illinois, mean flows in Pecatonica River at Freeport and Skillet Fork at Wayne City respectively, increased in contrast to the normal seasonal pattern of decreasing flows, were 2 times the May median discharges for those two sites, and were above the normal range. In the central part of the State, mean flow in Sangamon River at Monticello decreased seasonally but remained within the normal range. (See graph on page 8.)

In Wisconsin, monthly mean flows decreased seasonally except in the eastern part of the State where

(Continued on page 8.)

SELECTED DATA FOR THE GREAT LAKES, GREAT SALT LAKE, AND OTHER HYDROLOGIC SITES

GREAT LAKES LEVELS

Water levels are expressed as elevations in feet above International Great Lakes Datum 1955

(Data furnished by National Ocean Survey, NOAA, via U.S. Army Corps of Engineers office in Detroit. To convert data to elevations above mean sea level datum of 1929, add the following values: Superior, 0.96; Michigan-Huron, 1.20; St. Clair, 1.24; Erie, 1.57; Ontario, 1.22.)

Lake	May 31, 1978	Monthly mean, May		May		
		1978	1977	Average 1900–75	Maximum (year)	Minimum (year)
Superior (Marquette, Mich.)	600.52	600.32	600.12	600.38	601.53 (1951)	598.30 (1926)
Michigan and Huron (Harbor Beach, Mich.)	578.87	578.73	578.57	578.31	580.60 (1973)	575.79 (1964)
St. Clair (St. Clair Shores, Mich.)	574.72	574.77	574.45	573.58	576.06 (1974)	571.64 (1934)
Erie (Cleveland, Ohio)	572.35	572.38	571.94	570.82	573.25 (1973)	568.43 (1934)
Ontario (Oswego, N.Y.)	246.50	246.61	245.21	245.42	247.95 (1952)	242.67 (1935)

GREAT SALT LAKE

Alltime high: 4,211.6 (1873). Alltime low: 4,191.35 (October 1963).	May 31, 1978	May 31, 1977	Reference period 1904–77		
			May average, 1904–77	May maximum (year)	May minimum (year)
Elevation in feet above mean sea level:	4,200.25	4,200.70	4,199.1	4,204.9 (1923)	4,192.8 (1963)

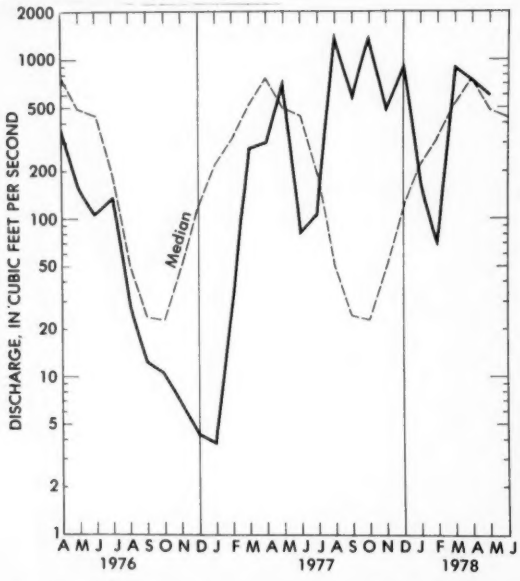
LAKE CHAMPLAIN, AT ROUSES POINT, N.Y.

Alltime high (1827–1975): 102.1 (1869). Alltime low (1939–1975): 92.17 (1941).	May 30, 1978	May 31, 1977	Reference period 1939–75		
			May average, 1939–75	May max. daily (year)	May min. daily (year)
Elevation in feet above mean sea level:	98.45	96.90	95.33	101.44 (1972)	94.91 (1965)

FLORIDA

Site	May 1978		April 1978	May 1977
	Discharge in cfs	Percent of normal	Discharge in cfs	Discharge in cfs
Silver Springs near Ocala (northern Florida)	870	113	900	780
Miami Canal at Miami (southeastern Florida)	235	184	197	84.4
Tamiami Canal outlets, 40-mile bend to Monroe	71	2,770	93	0

(Continued from page 6.)



Monthly mean discharge of Sangamon River at Monticello, Ill. (Drainage area, 550 sq mi; 1,424 sq km)

mean discharge in Fox River at Rapide Croche Dam, near Wrightstown increased, in contrast to the normal seasonal pattern of decreasing flow, and was in the above-normal range. In the northwestern part of the State, mean flow in Jump River at Sheldon and Chippewa River at Chippewa Falls decreased seasonally, were only about 1/3 the May median flows, and were below the normal range. Minor flooding occurred in the southern part of the State near midmonth as a result of runoff from reported rainfall of 4 inches to about 7 inches May 13, 14. Peak discharge in Cheboygan River at Cheboygan Falls was equal to that of a 5-year flood. Other peak discharges generally were about equal to that of the mean annual flood at their respective sites.

In Minnesota, monthly mean flows decreased seasonally at all index stations and were in the normal range. In Red River of the North basin, in the western part of the State, mean flow in Buffalo River near Dilworth decreased sharply from the record-high flow of April, and was less than median. In the north-central part of the State, monthly mean flow in Mississippi River at St. Paul also decreased seasonally and was slightly less than the median flow for May.

In southwestern Ontario, mean flow in English River at Umfreville increased seasonally and was in the normal range but was less than median. In the eastern part of the Province, mean flow increased seasonally in Missinaibi River at Mattice and decreased seasonally in Saugeen River near Port Elgin, but was within the normal range at each station.

In Michigan, monthly mean flows decreased seasonally in all parts of the State, were slightly less than median, and were in the normal range. In the Upper Peninsula, mean flow in Sturgeon River near Sidnaw decreased but was 98 percent of median. In the northern part of the Lower Peninsula, mean flow in Muskegon River at Evart decreased to less than one-half the mean flow observed in April but was 85 percent of median. In the southern part of the State, mean flow in Red Cedar River at East Lansing also decreased to less than one-half the April mean discharge but was 95 percent of the median discharge for May.

In Ohio, monthly mean flows decreased seasonally except in the northeastern part of the State where mean flow in Little Beaver Creek near East Liverpool increased, in contrast to the normal seasonal pattern of decreasing flow, and was above the normal range for the 9th time in the past 11 months. In northwestern Ohio, where mean flow in Maumee River at Waterville was in the above-normal range in March and April, flow decreased sharply in May and was only 65 percent of median for the month.

Ground-water levels in shallow water-table wells in Minnesota rose and continued above average in the southern part of the State, and rose but continued below average in the north. In the Minneapolis-St. Paul area, artesian levels began to decline in wells tapping the Prairie du Chien-Jordan aquifer but rose slightly in the deeper Mt. Simon-Hinckley aquifer; levels in both continued below average. In Wisconsin, levels in water-table wells continued the statewide rising trend that began in April. With the approach of the summer season, levels in the deep sandstone aquifers in the heavily-pumped metropolitan areas declined slightly owing to increased pumping. In Michigan, levels declined in the southern half of the Lower Peninsula but continued to rise elsewhere. Levels were generally below average in most areas. In Illinois, the level in the shallow index well in glacial drift at Princeton, in Bureau County, rose ½ foot and continued above average. Levels in Indiana continued to rise statewide, and were about average except in the southwestern and south-central parts of the State, where they were moderately above average. In Ohio, levels declined but were average in the northeast, and above average in the central part of the State.

MIDCONTINENT

[Manitoba and Saskatchewan; Arkansas, Iowa, Kansas, Louisiana, Missouri, Nebraska, North Dakota, Oklahoma, South Dakota, and Texas]

Streamflow increased seasonally in Manitoba, Kansas, and Oklahoma, and in parts of Missouri and Texas,

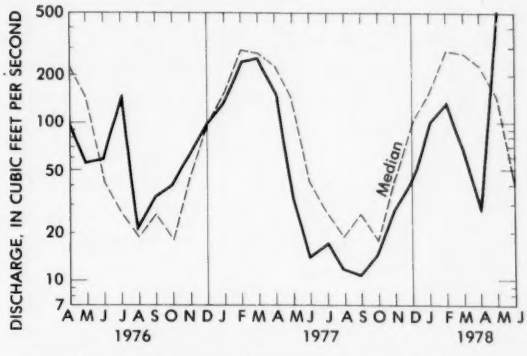
decreased seasonally in Saskatchewan, North Dakota, and South Dakota, and was variable elsewhere in the region. Monthly mean flows remained above the normal range in parts of North Dakota, Iowa, Missouri, and Kansas, and remained below the normal range in part of Texas. Flooding occurred in parts of Iowa, Kansas, Louisiana, Missouri, Oklahoma, and Texas.

Ground-water levels declined but were above average in Iowa, mostly declined but were above average in Nebraska, and declined with below-average levels in Texas. Mixed trends prevailed elsewhere in the region. New lows for May occurred in Kansas, Arkansas, and Louisiana, and two new alltime lows were measured in Texas.

In the panhandle of northern Texas, severe flash flooding in Palo Duro Canyon on Prairie Dog Town Fork Red River, near Amarillo, resulted from rapid runoff of heavy rainfall, reported to have been more than 5 inches, falling on nearly-saturated ground. All roads into the canyon were reported to be washed out, three persons were known to have drowned, and the 4-lane divided highway between Amarillo and Canyon (a town 20 miles south of Amarillo) was described as a quagmire after the flood subsided. A peak discharge of 50,000 cfs occurred May 27 on that stream at the gaging station near Wayside (drainage area, 4,211 square miles), about 30 miles southeast of Amarillo. On May 28, a peak discharge of 56,000 cfs occurred downstream on that stream at the gaging station near Childress (drainage area, 7,725 square miles), and on May 29, a peak discharge of 74,000 cfs occurred farther downstream on Red River near Quanah (drainage area, 8,321 square miles). The latter two discharges are equal to that of a 50-year flood at the respective sites. In the eastern part of the State, monthly mean flow in Neches River near Rockland decreased, in contrast to the normal seasonal pattern of increasing flow for that site, was only 13 percent of the May median discharge, and remained below the normal range for the 3d consecutive month. In southern Texas, mean flow in Guadalupe River near Spring Branch also decreased, contrary to the normal seasonal pattern of increasing flow, was 1/3 of median, and was below the normal range. Drought conditions were reported to be continuing in all parts of the State except in the lower Nueces River basin in the southern part, and in the upper Colorado River, Pecos River, and Devils River basins in western Texas, where streamflows were in the normal range. Storage in the majority of reservoirs in the State decreased during May and that in Lake Travis near Austin was the lowest observed since January 1965.

Runoff from the same storm that caused the flooding in the Texas Panhandle caused lowland flooding along small streams in western Oklahoma near monthend. Bankfull stages occurred along some of the major streams in the western half of the State. A flood-water release of 6,400 cfs was made from Lake Altus in the southwestern part of the State. Monthly mean flow at the index station, Washita River near Durwood, also in southwestern Oklahoma, increased seasonally and was in the normal range.

In southeastern Louisiana, stages on Pearl River near Bogalusa were above the National Weather Service flood stage of 15 feet May 4–27. In the New Orleans area, also in southeastern Louisiana, widespread flooding occurred May 3, as a result of runoff from rainfall amounts reported to be as much as 10 inches, because drainage pump capacity was reported to have been insufficient for removing the unusually high rate of runoff generated by that storm. In central Louisiana, the rain gage at the index streamflow station, Saline Bayou near Lucky, recorded 4.84 inches for the 24-hour day, May 7, and 2.5 inches for one 30-minute period during that day. Runoff from this storm caused minor flooding along some streams in that area. Monthly mean flow at the index station increased sharply, from the record-low mean discharge of 27.7 cfs in April (12 percent of median) to 511 cfs in May (357 percent of median). (See graph.) Prior to this storm the daily mean discharge of 6.4 cfs on May 2 was lowest for the month since records began in June 1940. In southwestern Louisiana, mean flow in Calcasieu River near Oberlin decreased seasonally, was only 11 percent of median, and remained below the normal range for the 3d consecutive month.



Monthly mean discharge of Saline Bayou near Lucky, La. (Drainage area, 154 sq mi; 399 sq km)

In southern Arkansas, where mean flow in Saline River near Rye was below the normal range and only 23 percent of median in April, flow increased sharply as a result of runoff from rains near midmonth and monthly mean discharge was greater than median and in the normal range. In the northern part of the State, mean flow in Buffalo River near St. Joe also increased, in

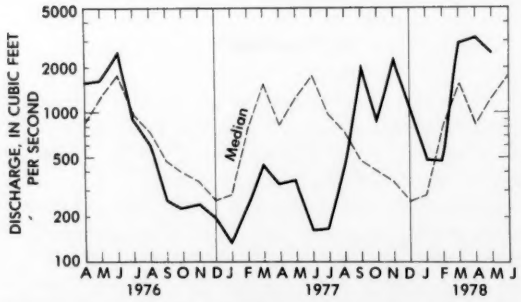
contrast to the normal seasonal pattern of decreasing flow, and was well above the May median discharge and in the normal range. Monthly mean flow at this index station in April was below the normal range and only ½ of the April median discharge.

In western and north-central parts of Missouri, lowland flooding occurred May 9 and 24 along Grand River, Chariton River, and the upper reaches of Osage River. Monthly mean flow in Grand River near Gallatin decreased but was 3 times median and remained above the normal range as a result of high carryover flow from April, augmented by runoff from rains early in May. In the central part of the State, mean flow in Gasconade River at Jerome increased seasonally and remained in the normal range.

In southwestern Kansas, runoff from a severe thunderstorm on May 1, during which 5 to 7 inches of rain reportedly fell near Dodge City, resulted in flash flooding along Mulberry Creek and caused some damage to agricultural land and crops. In the eastern part of the State, as much as 7 inches of rain was reported to have fallen during the 2-day period May 23–24, resulting in flash flooding in the upper reaches of Marais des Cygnes River basin and causing some damage to crops and cropland. In Little Blue River basin in northeastern Kansas and the adjacent area of southeastern Nebraska, mean flow as measured at Barnes, Kans., increased seasonally, was 2 times the median discharge, and remained above the normal range for the 3d consecutive month. In the northwestern part of the State, where monthly mean flow in Saline River near Russell has been in the below-normal range continuously since October 1977, mean flow increased seasonally in May and was in the normal range. In southern Kansas, mean flow in Arkansas River at Arkansas City also increased seasonally, as a result of runoff from rains May 21–22, and remained in the normal range.

In Iowa, streamflow increased sharply and high stages occurred early in the month along Chariton River and South Fork Chariton River, in the southwestern part of the State, as a result of runoff from rains associated with the same storm system that caused flooding May 9 along Chariton River downstream in Missouri. Also in southwestern Iowa, mean flow in Nishnabotna River above Hamburg decreased, in contrast to the normal seasonal pattern of increasing flow, but remained in the above-normal range for the 3d consecutive month. (See graph.) Elsewhere in the State, mean flows decreased seasonally and remained within the normal range.

In Nebraska, mean flows at the two index stations continued to decrease seasonally and were in the normal range, concurrently, for the first time since October 1977. In the northwestern part of the State (Panhandle),



Monthly mean discharge of Nishnabotna River above Hamburg, Iowa (Drainage area, 2,806 sq mi; 7,268 sq km)

where monthly mean flow in Niobrara River above Box Butte Reservoir was below the normal range in April and in 4 of the preceding 5 months, daily mean flows increased as a result of runoff from rains early in May, and the monthly mean flow was greater than median and in the normal range. In eastern Nebraska, where monthly mean flow in Elkhorn River at Waterloo was above the normal range in March and April, mean discharge also decreased seasonally and was in the normal range. Along the southern border of the panhandle, flow in Lodgepole Creek basin continued in the below-normal range. Flash flooding occurred along several streams in different parts of the State as a result of rapid runoff from intense thunderstorm rainfall during the month. In the Republican River basin in southwestern Nebraska, the water level in Harry Strunk Reservoir, on Medicine Creek near Cambridge, reached the top of the conservation pool during the month and stop logs were placed on the spillway to contain an extra 2 feet of water for irrigation purposes. Monthend levels in other reservoirs in that basin were below the respective conservation pool elevations.

In Big Sioux River basin, in eastern South Dakota and the adjacent areas of Minnesota and Iowa, where mean flow as measured at Akron, Iowa was above the normal range in March and April, flow decreased seasonally in May and the monthly mean was in the normal range. Similarly, in the central part of the State, where mean flows in March and April in Bad River near Fort Pierre were above the normal range, flow decreased seasonally in May and was in the normal range.

In eastern North Dakota, where thousands of acres of land along Red River of the North were inundated in April by flood waters that crested April 11 at the index station at Grand Forks, monthly mean flow decreased from the above-normal range in April to the normal range in May. In the western part of the State, high carryover flow from April in Cannonball River at Breien, augmented by increased runoff near the end of May, held monthly mean discharge in the above-normal range

for the 3d consecutive month. Cumulative runoff at this station for the first 8 months of the 1978 water year was 576 percent of median.

In southeastern Saskatchewan, mean flow in Qu'Appelle River near Lumsden decreased seasonally, was only 26 percent of the median discharge for May, and was below the normal range.

In southern Manitoba, monthly mean flow in Waterhen River below Waterhen Lake increased seasonally, was slightly greater than median and was in the normal range. The level of Lake Winnipeg at Gimli averaged 713.55 feet above mean sea level for the month, 0.05 foot lower than the long-term average for May, 0.48 foot higher than last month, and 1.88 feet higher than a year ago. The record of Lake Winnipeg levels began in May 1913 at Winnipeg Beach.

Ground-water levels in North Dakota rose in the west, declined in the east, and were near average statewide. Levels in Nebraska changed little; there were slight declines in alluvial aquifers along major streams, but levels were above average statewide. In Iowa, levels in shallow water-table wells declined nearly statewide, but were above average. In Kansas, levels rose in the northeastern and south-central parts of the State, but declined slightly elsewhere; levels were below average except in the northeast. The level in the index well at Colby was at a new low for May in 30 years of record. In the rice-growing area of east-central Arkansas, the level in the shallow Quaternary aquifer rose slightly, and was in the same range that has prevailed since 1961. The level in the deep aquifer——the Sparta Sand——declined 4.7 feet, and was about 2 feet below average. In the Sparta Sand industrial aquifer of central and south Arkansas, the level in the key well at Pine Bluff rose slightly, was about 14 feet below average, and at a new low for May in 12 years of record. At El Dorado, the level declined 1½ feet, and was 2½ feet below average. In Louisiana, levels continued to decline in deeper aquifers but some recovery took place among shallower aquifers. Levels in the "600-foot sand" of the Baton Rouge area were the highest since detailed records began in the early 1940's. Levels in wells in the Miocene sands of central Louisiana and the Sparta Sand of northern Louisiana continued to indicate regional declines. Dry conditions prevailed in southwestern Louisiana: record lows for May were measured in 9 of 16 observation wells. Levels in the Chicot aquifer declined in response to heavy pumping for rice irrigation; the key well in this aquifer near Iowa, La., declined 13.6 feet, again reaching a new low for the month in 38 years of record. In Texas, levels in key wells in the Edwards Limestone declined but were above average at Austin, and declined and were below average at San Antonio. Levels in wells in the Evangeline aquifer at Houston declined and were below average; levels in wells in the bolson deposits at El Paso declined and were below average. New alltime lows were reached in the key wells at El Paso and in the Ogallala Formation at Plainview in the Texas Panhandle.

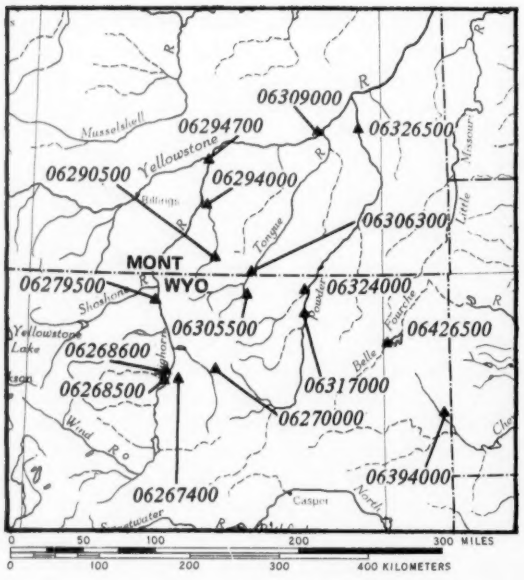
WEST

[Alberta and British Columbia; Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming]

Streamflow generally increased seasonally in most of the region but decreased in Arizona and Nevada and was variable in California, New Mexico, Oregon and Washington. Monthly mean flows remained in the above-normal range in parts of Arizona, California, Nevada, and Utah, and increased into that range in parts of Oregon, Montana, and Wyoming. Below-normal streamflow persisted in parts of Oregon and Washington and decreased into that range in parts of British Columbia, Colorado, New Mexico, and Utah. Severe flooding occurred in Montana and Wyoming.

Ground-water levels showed mixed trends in most of the region. Levels were below average in Idaho, New Mexico, Utah, and Washington, and were above and below average in Arizona, southern California, and Nevada. A new high level for May occurred in Arizona, and a new alltime high in Nevada; new low levels for May were reached in Arizona and Idaho, and a new alltime low occurred also in Idaho.

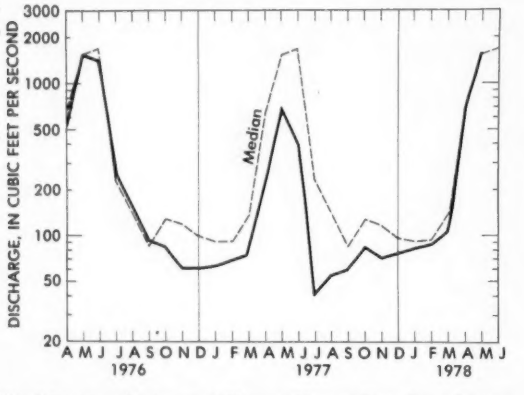
Severe flooding occurred in southeastern Montana and northeastern Wyoming along the Yellowstone and Cheyenne Rivers and their tributaries during the period May 17–23. The floods were the result of unusually heavy precipitation and caused massive flood damage, particularly along the Little Bighorn River in Bighorn County, Montana. Five counties in Montana (Bighorn, Powder River, Rosebud, Treasure, and Yellowstone) were proclaimed eligible for Federal disaster relief with estimated damage at $10 million. One death, attributed to the flooding, occurred along Pryor Creek near Pryor, Mont. Many gaging stations in the area recorded all-time high peak discharges following the storm. Selected data on stages, discharges, recurrence intervals, and gaging station locations, are given in the accompanying map and table on pages 12 and 13. Keyhole Reservoir, on the Belle Fourche River in Wyoming, recorded its highest stage and contents since construction in 1952. Monthly mean flow at Billings, Montana, on the Yellowstone River, increased sharply as a result of the flood runoff and was



Location of stream-gaging stations in Montana and Wyoming, described in table of peak stages and discharges.

above the normal range, although far below the record flow at that site. Monthly mean flows at the remaining index stations in Montana and Wyoming increased seasonally and were in the normal range.

In Colorado, streamflow increased seasonally at all index stations and was generally in the normal range. However, at Roaring Fork River at Glenwood Springs, the seasonal increase in flow was less than normal and the monthly mean discharge at that site in west-central Colorado was below the normal range. At Yampa River at Steamboat Springs, in the northwestern part of the State, monthly mean flow remained slightly above median and within the normal range. (See graph.)



Monthly mean discharge of Yampa River st Steamboat Springs, Colo. (Drainage area, 604 sq mi; 1,564 sq km)

In southeastern New Mexico, mean flow in Delaware River near Red Bluff was 87 percent less than the mean flow in April, in contrast to the normal seasonal increase of 130 percent at that site, and was well below the normal range, reflecting the drought conditions in that area. Streamflows in the remainder of the State generally increased seasonally and were within the normal range.

In southern Arizona, monthly mean discharge in San Pedro River at Charleston decreased sharply but remained in the above-normal range for the 8th consecutive month as a result of high carryover flow from April. Mean flows at the remaining index stations in the State also decreased seasonally, were above the median flows, but within the normal range. Storage decreased in all major reservoirs during the month.

In southern Nevada and the adjacent areas of Arizona and Utah, monthly mean flow in Virgin River as measured at Littlefield, Ariz. decreased seasonally but, as a result of high carryover flow from April, augmented by increased runoff near the end of the month, remained in the above-normal range for the 5th consecutive month. Monthly mean flows elsewhere in Nevada were generally less than median but within the normal range.

In north-central Utah, where mean flow in Big Cottonwood Creek near Salt Lake City was above the normal range and 132 percent of median in April, the seasonal increase in flow was less than expected and flow during May was only 90 percent of median and below the normal range. Similarly, in the northwestern part of the State, the seasonal increase in flow in Whiterocks River near Whiterocks was also less than expected and the monthly mean discharge at that site was below the normal range. Elsewhere in the State, streamflow increased seasonally and was within the normal range although considerably lower than expected as a result of below-normal temperatures that retarded snowmelt. Streamflow averaged 98 percent of median at the seven index stations, compared to only 23 percent a year ago.

In Idaho, reservoir storage continued to increase but remained below average. Streamflow generally increased seasonally throughout the State and was within the normal range.

In Alberta, monthly mean flows at the two index stations, Athabasca River at Hinton and Bow River at Banff increased seasonally, were less than median, but remained within the normal range.

In northern British Columbia, streamflow in Skeena River at Usk increased seasonally but was below the normal range at only 69 percent of median. In the southern part of the Province, mean flow in Fraser River at Hope also increased seasonally but was below the normal range for the first time since June 1977.

In eastern Washington, monthly mean discharge in Spokane River at Spokane increased seasonally to 79 percent of median but was below the normal range for the first time since October 1977. At higher elevations in

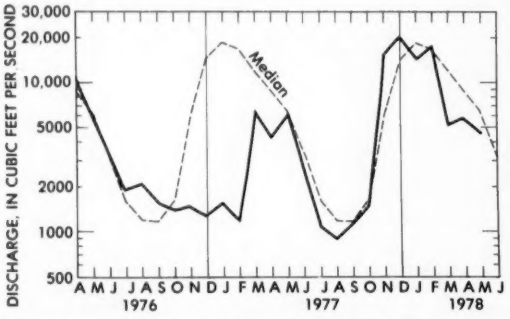
FLOOD DATA FOR SELECTED SITES IN MONTANA AND WYOMING, MAY 1978

WRD station number	Stream and place of determination	Drainage area (square miles)	Period of known floods	Maximum flood previously known			Maximum during present flood				
				Date	Stage (feet)	Discharge (cfs)	Date	Stage (feet)	Discharge		Recurrence interval (years)
									Cfs	Cfs per square mile	
	MONTANA										
	YELLOWSTONE RIVER BASIN										
06290500	Little Bighorn River below Pass Creek, near Wyola	428	1939–	June 14, 1963	7.43	3,630	May 19	9.74	4,850	11.3	>100
06294000	Little Bighorn River near Hardin	1,294	1953–	Apr. 2, 1965	6.7	4,520	19	11.20	21,500	16.6	>100
06244700	Bighorn River at Bighorn	22,885	1945–	June 24, 1947	[a]8.79	26,200	20	14.73	55,440	2.4	>100
06306300	Tongue River at State line, near Decker	1,477	1960–	June 15, 1967	10.86	7,480	19	14.26	19,500	13.2	>100
06309000	Yellowstone River at Miles City	48,253	1922–23, 1928–	June 19, 1944	[a]12.74	96,300	22	16.50	103,000	2.1	>100
06326500	Powder River near Locate	13,194	1938–	Feb. 19, 1943	[a]11.23	31,000	22	11.2	29,000	.....	15
	WYOMING										
	YELLOWSTONE RIVER BASIN										
06267400	East Fork Nowater Creek near Colter	149	1971–	July 6, 1975	3.68	1,270	May 18	6.65	3,800	25.5	.....
06268500	Fifteen Mile Creek near Worland	518	1951–	May 22, 1952	[a]5.77	3,300	18	10.76	4,350	8.4	100
06268600	Bighorn River at Worland	10,810	1965–69	June 23, 1967	13.69	15,900	19	.....	[b]17,500	1.6	.....
06270000	Nowood River near Ten Sleep	803	1938–43, 1950–55, 1972–	June 16, 1955	12.3	3,330	19	12.85	3,330	4.2	20
06279500	Bighorn River at Kane	15,765	1928–	June 16, 1935	11.10	25,200	20	9.95	20,500	1.3	10
06305500	Goose Creek below Sheridan	392	1941–	June 16, 1963	7.82	5,450	18	8.30	5,450	13.9	50
06317000	Powder River at Arvada	6,050	1919–	Sept. 29, 1923	23.7	[b]100,000	20	16.87	[b]35,000	5.8	50
06324000	Clear Creek near Arvada	1,110	1915–19, 1928–29, 1939–	Aug. 5, 1954	10.45	9,600	19	9.04	5,200	4.7	10
	CHEYENNE RIVER BASIN										
06394000	Beaver Creek near Newcastle	1,320	1943–	June 16, 1962	19.98	11,900	20	16.2	[b]3,400	2.6	25
06426500	Belle Fourche River below Moorcroft	1,670	1908–	June 1908 April 7, 1924	[c] [a]12.6	unknown 12,500	19	14.5	[b]15,000	9.0	>100

[a] Site and datum then in use.
[b] About.
[c] Peak stage 2.5 feet higher than peak of Apr. 7, 1924.

the northwestern part of the State, mean flows were generally below the normal range.

In northwestern Oregon, in Wilson River near Tillamook, monthly mean discharge decreased seasonally but was above the normal range at nearly 2 times the median flow for May. In the southeastern part of the State, monthly mean flow in Umpqua River near Elkton also decreased seasonally and remained in the below-normal range for the 3d consecutive month. (See graph.) Storage in Upper Klamath Lake, McKay Reservoir, and Lake Owyhee increased seasonally with Lake Owyhee, in the eastern part of the State, spilling water as a result of minor flooding in the area.



Monthly mean discharge of Umpqua River near Elkton, Oreg. (Drainage area, 3,683 sq mi; 9,539 sq km)

In southern California, monthly mean flow in Arroyo Seco near Pasadena decreased seasonally and as a result of high carryover flow from April, remained in the above-normal range for the 5th consecutive month. In central California, on the Sierra Nevada west slope, mean flow in Kings River above North Fork, near Trimmer, increased seasonally, was 166 percent of median, and was above the normal range for the 4th time in the past 5 months. In the northern part of the State, monthly mean flows at the index stations were near or above median, but within the normal range. In the southern end of the Sierra Nevada, snowpack remained well above normal and a potential flood threat existed in the Kern, Kawech, Kings, and San Joaquin River drainages.

Combined contents of 10 of the major reservoirs in northern California were 96 percent of average and 2.2 times that of a year ago. Contents of the Colorado River Storage Project increased 1,513,910 acre-feet during the month.

Ground-water levels in Washington showed mixed trends. The level in the western key well declined slightly and was nearly 3 feet below average; the level in the eastern well in the Spokane Valley rose slightly but was nearly a foot below average. In Idaho, the level in the well in the sand and gravel aquifer in the Boise Valley rose slightly but was below average. Levels in key wells in the Snake River Plain aquifer declined to a near-record low in the east near Atomic City, and declined and was below average in the Rupert-Minidoka area. The level in the well near Eden declined to a new low in 21 years of record, and a new low for May was recorded in the well near Gooding in the western part of the plain. The level in the key well in the alluvial aquifer underlying the Rathdrum Prairie, northern Idaho, rose slightly for the second consecutive month but continued more than 8 feet below average. In southern California, levels in selected observation wells in Santa Barbara County rose in Santa Maria and Cuyama Valleys, reaching a new alltime high in 28 years of record in the latter; the level declined in the well at Lompoc in the Santa Ynez Valley but was more than 9 feet above average. The level declined and continued below average in the well in the Los Alamitos area, Orange County, and rose but continued below average at Baldwin Park in Los Angeles County. In Nevada, the level declined in the Paradise Valley well but continued above average, rose and was at a new alltime high in 28 years of record in the Steptoe Valley well, and rose but continued below average in the Truckee Meadows well. Levels rose in Utah except in the Holladay area, but continued below average statewide. In Arizona, levels declined in three index wells and rose in two; a new May low and a new May high were measured. In New Mexico, levels in the Roswell basin rose in the Dayton water-table well and in the Berrendo-Smith artesian well, and declined in the Hagerman West well; levels were below average in all three index wells.

ALASKA

In the south-coastal basin of Kenai River, mean flow at the index station at Cooper Landing increased seasonally as a result of snowmelt runoff from the above-normal snowpack in the mountains of the Kenai Peninsula and remained in the above-normal range for the 4th consecutive month. Elsewhere in the State, the seasonal increase in streamflow at Little Susitna River near Palmer and Chena River at Fairbanks was less than normal as a result of a below-normal snowpack and below-normal precipitation during May and mean flows at those sites were below the normal range. Breakup on the streams in interior Alaska occurred about a week earlier than in the past several years.

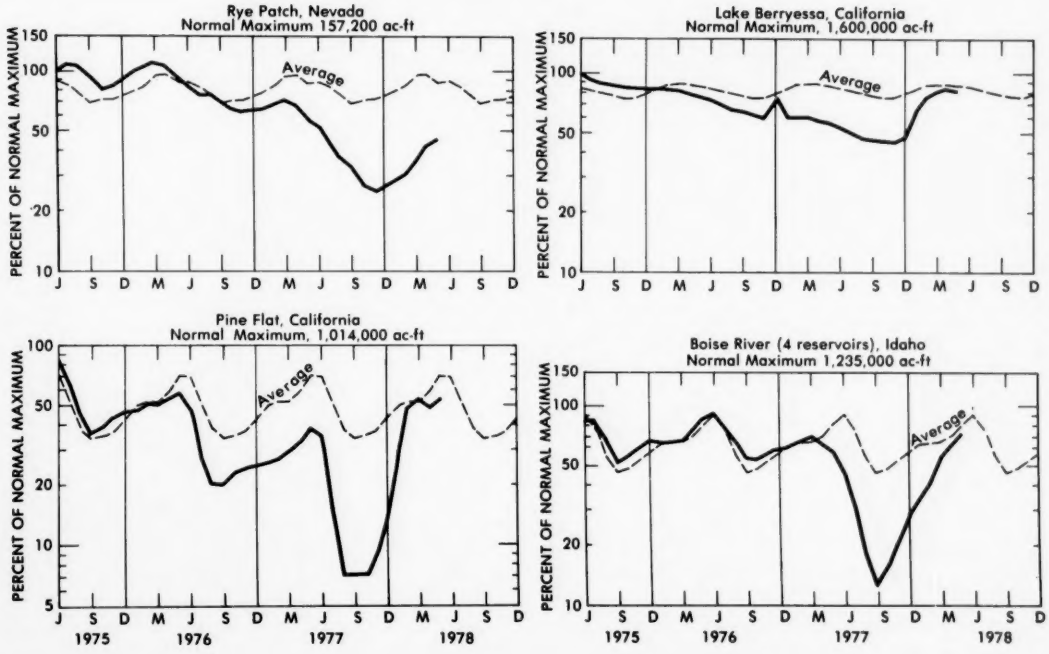
Ground-water levels representing the confined aquifer system declined from ½ to 3 feet throughout the Anchorage area, except in the North Fork Campbell Creek fan area near the mountains where levels rose 1 foot. Generally, the shallow water table remained unchanged from last month.

HAWAII

Streamflow generally increased throughout the State as a result of above-normal precipitation and was in the normal range at all index stations on the four major islands.

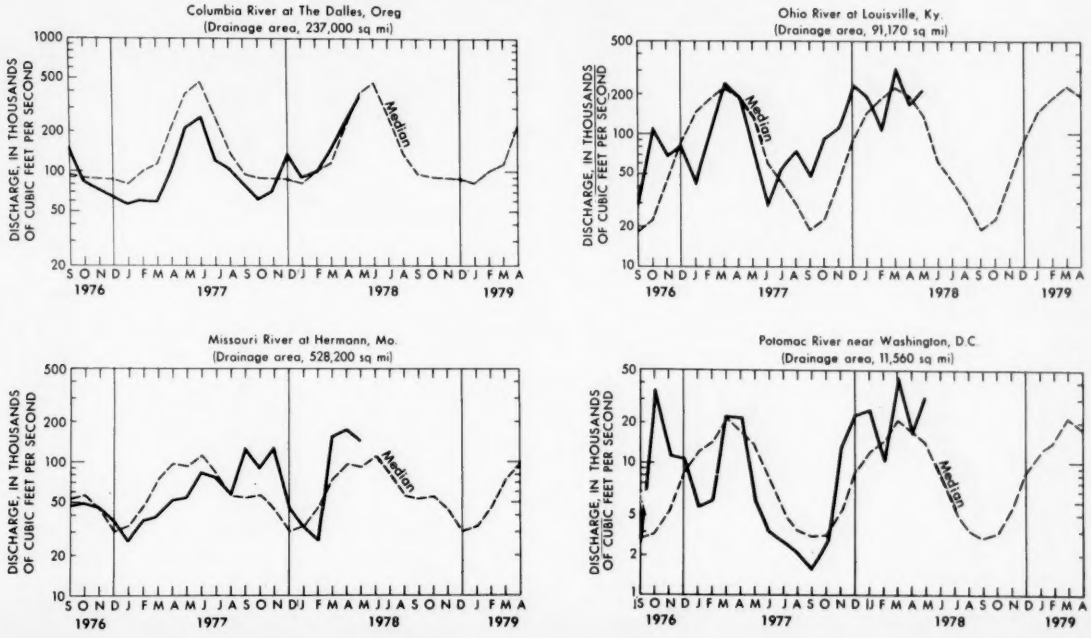
On Guam, Mariana Islands, monthly mean flow at Ylig River near Yona decreased sharply and was only 36 percent of median. Mean flow at Yona has been below the normal range in 4 of the last 5 months.

USABLE CONTENTS OF SELECTED RESERVOIRS AND RESERVOIR SYSTEMS, JUNE 1975 TO MAY 1978



Contents of reservoirs in various parts of the West generally increased in May as a result of snowmelt runoff but most remained slightly below average. Much below-average contents characterized Rye Patch Reservoir in Nevada (See graph above.)

HYDROGRAPHS OF FOUR LARGE RIVERS


Columbia River at The Dalles, Oreg
(Drainage area, 237,000 sq mi)
Ohio River at Louisville, Ky.
(Drainage area, 91,170 sq mi)
Missouri River at Hermann, Mo.
(Drainage area, 528,200 sq mi)
Potomac River near Washington, D.C.
(Drainage area, 11,560 sq mi)
DISCHARGE, IN THOUSANDS OF CUBIC FEET PER SECOND
Median
S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A
1976
1977
1978
1979

USABLE CONTENTS OF SELECTED RESERVOIRS NEAR END OF MAY 1978

[Contents are expressed in percent of reservoir capacity. The usable storage capacity of each reservoir is shown in the column headed "Normal maximum."]

Reservoir Principal uses: F–Flood control I–Irrigation M–Municipal P–Power R–Recreation W–Industrial	End of Apr. 1978	End of May 1978	End of May 1977	Average for end of May	Normal maximum
	Percent of normal maximum				
NORTHEAST REGION					
NOVA SCOTIA					
Rossignol, Mulgrave, Falls Lake, St. Margaret's Bay, Black, and Ponhook Reservoirs (P)	75	80	88	77	226,300 (a)
QUEBEC					
Allard (P)	81	91	86	87	280,600 ac-ft
Gouin (P)	54	69	78	60	6,954,000 ac-ft
MAINE					
Seven reservoir systems (MP)	62	96	94	90	178,500 mcf
NEW HAMPSHIRE					
First Connecticut Lake (P)	14	91	93	87	3,330 mcf
Lake Francis (FPR)	31	79	81	81	4,326 mcf
Lake Winnipesaukee (PR)	97	107	107	101	7,200 mcf
VERMONT					
Harriman (P)	70	91	83	87	5,060 mcf
Somerset (P)	61	82	88	86	2,500 mcf
MASSACHUSETTS					
Cobble Mountain and Borden Brook (MP)	88	95	88	90	3,394 mcf
NEW YORK					
Great Sacandaga Lake (FPR)	90	97	97	98	34,270 mcf
Indian Lake (FMP)	68	108	98	104	4,500 mcf
New York City reservoir system (MW)	99	101	100	.....	547,500 mg
NEW JERSEY					
Wanaque (M)	100	102	95	94	27,730 mg
PENNSYLVANIA					
Allegheny (FPR)	44	52	49	46	51,400 mcf
Pymatuning (FMR)	98	104	99	99	8,191 mcf
Raystown Lake (FR)	68	67	67	52	33,190 mcf
Lake Wallenpaupack (PR)	72	87	87	85	6,875 mcf
MARYLAND					
Baltimore municipal system (M)	100	100	93	94	85,340 mg
SOUTHEAST REGION					
NORTH CAROLINA					
Bridgewater (Lake James) (P)	93	93	94	92	12,580 mcf
Narrows (Badin Lake) (P)	98	97	93	100	5,617 mcf
High Rock Lake (P)	90	91	84	82	10,230 mcf
SOUTH CAROLINA					
Lake Murray (P)	94	94	91	82	70,300 mcf
Lakes Marion and Moultrie (P)	87	86	85	78	81,100 mcf
SOUTH CAROLINA--GEORGIA					
Clark Hill (FP)	77	79	76	76	75,360 mcf
GEORGIA					
Burton (PR)	91	99	98	93	104,000 ac-ft
Sinclair (MPR)	90	93	95	93	214,000 ac-ft
Lake Sidney Lanier (FMPR)	65	65	66	67	1,686,000 ac-ft
ALABAMA					
Lake Martin (P)	88	98	99	94	1,373,000 ac-ft
TENNESSEE VALLEY					
Clinch Projects: Norris and Melton Hill Lakes (FPR)	50	66	66	66	1,156,000 cfsd
Douglas Lake (FPR)	35	68	68	70	703,100 cfsd
Hiwassee Projects: Chatuge, Nottely, Hiwassee, Apalachia, Blue Ridge, Ocoee 3, and Parksville Lakes (FPR)	65	76	91	83	510,300 cfsd
Holston Projects: South Holston, Watauga, Boone, Fort Patrick Henry, and Cherokee Lakes (FPR)	51	67	68	70	1,452,000 cfsd
Little Tennessee Projects: Nantahala, Thorpe, Fontana, and Chilhowee Lakes (FPR)	57	69	83	85	745,200 cfsd
WESTERN GREAT LAKES REGION					
WISCONSIN					
Chippewa and Flambeau (PR)	70	84	86	86	15,900 mcf
Wisconsin River (21 reservoirs) (PR)	54	69	56	82	17,400 mcf
MINNESOTA					
Mississippi River headwater system (FMR)	28	33	23	37	1,640,000 ac-ft
MIDCONTINENT REGION					
NORTH DAKOTA					
Lake Sakakawea (Garrison) (FIPR)	79	86	79	.....	22,640,000 ac-ft
SOUTH DAKOTA					
Angostura (I)	97	101	70	89	127,600 ac-ft
Bell Fourche (I)	97	101	66	73	185,200 ac-ft
Lake Francis Case (FIP)	87	84	84	83	4,834,000 ac-ft
Lake Oahe (FIP)	96	98	83	.....	22,530,000 ac-ft
MIDCONTINENT REGION--Continued					
SOUTH DAKOTA--Continued					
Lake Sharpe (FIP)	103	104	102	99	1,725,000 ac-ft
Lewis and Clarke Lake (FIP)	80	82	81	86	477,000 ac-ft
NEBRASKA					
Lake McConaughy (IP)	76	76	81	79	1,948,000 ac-ft
OKLAHOMA					
Eufaula (FPR)	99	105	102	93	2,378,000 ac-ft
Keystone (FPR)	94	103	130	107	661,000 ac-ft
Tenkiller Ferry (FPR)	105	107	101	102	628,200 ac-ft
Lake Altus (FIMR)	81	90	99	67	134,500 ac-ft
Lake O'The Cherokees (FPR)	98	100	94	92	1,492,000 ac-ft
OKLAHOMA--TEXAS					
Lake Texoma (FMPRW)	84	85	109	103	2,722,000 ac-ft
TEXAS					
Bridgeport (IMW)	64	62	100	52	386,400 ac-ft
Canyon (FMR)	94	94	99	74	385,600 ac-ft
International Amistad (FIMPW)	92	91	102	75	3,497,000 ac-ft
International Falcon (FIMPW)	79	63	100	64	2,667,000 ac-ft
Livingston (IMW)	99	98	100	82	1,788,000 ac-ft
Possum Kingdom (IMPRW)	87	82	95	105	569,400 ac-ft
Red Bluff (PI)	7	7	16	27	307,000 ac-ft
Toledo Bend (P)	95	96	99	89	4,472,000 ac-ft
Twin Buttes (FIM)	77	74	100	24	177,800 ac-ft
Lake Kemp (IMW)	58	56	93	92	268,000 ac-ft
Lake Meredith (FMW)	34	33	38	37	821,300 ac-ft
Lake Travis (FIMPRW)	69	60	100	82	1,144,000 ac-ft
THE WEST					
WASHINGTON					
Ross (PR)	36	66	30	56	1,052,000 ac-ft
Franklin D. Roosevelt Lake (IP)	11	41	51	73	5,232,000 ac-ft
Lake Chelan (PR)	33	70	58	74	676,100 ac-ft
Lake Cushman	84	93	63	95	359,500 ac-ft
Lake Merwin (P)	101	101	106	103	246,000 ac-ft
IDAHO					
Boise River (4 reservoirs) (FIP)	64	73	57	80	1,235,000 ac-ft
Coeur d'Alene Lake (P)	75	109	109	126	238,500 ac-ft
Pend Oreille Lake (FP)	54	71	74	80	1,561,000 ac-ft
IDAHO--WYOMING					
Upper Snake River (8 reservoirs) (MP)	64	76	66	77	4,401,000 ac-ft
WYOMING					
Boysen (FIP)	56	61	74	64	802,000 ac-ft
Buffalo Bill (IP)	48	57	55	74	421,300 ac-ft
Keyhole (F)	76	104	72	46	199,900 ac-ft
Pathfinder, Seminoe, Alcova, Kortes, Glendo, and Guernsey Reservoirs (I)	47	56	64	57	3,056,900 ac-ft
COLORADO					
John Martin (FIR)	0	0	0	14	364,400 ac-ft
Taylor Park (IR)	26	32	60	74	106,200 ac-ft
Colorado–Big Thompson project (I)	24	30	50	64	722,600 ac-ft
COLORADO RIVER STORAGE PROJECT					
Lake Powell; Flaming Gorge, Navajo, and Blue Mesa Reservoirs (IFPR)	59	64	71	.....	31,280,000 ac-ft
UTAH--IDAHO					
Bear Lake (IPR)	60	67	72	68	1,421,000 ac-ft
CALIFORNIA					
Folsom (FIP)	82	88	30	87	1,000,000 ac-ft
Hetch Hetchy (MP)	25	58	24	69	360,400 ac-ft
Isabella (FIR)	51	64	13	40	551,800 ac-ft
Pine Flat (FI)	49	54	38	70	1,014,000 ac-ft
Clair Engle Lake (Lewiston) (P)	60	70	39	92	2,438,000 ac-ft
Lake Almanor (P)	79	88	64	62	1,036,000 ac-ft
Lake Berryessa (FIMW)	84	82	58	86	1,600,000 ac-ft
Millerton Lake (FI)	54	32	43	80	503,200 ac-ft
Shasta Lake (FIPR)	100	102	26	90	4,377,000 ac-ft
CALIFORNIA--NEVADA					
Lake Tahoe (IPR)	19	26	18	69	744,600 ac-ft
NEVADA					
Rye Patch (1)	43	46	56	87	157,200 ac-ft
ARIZONA--NEVADA					
Lake Mead and Lake Mohave (FIMP)	81	80	78	68	27,970,000 ac-ft
ARIZONA					
San Carlos (IP)	24	22	0	17	1,073,000 ac-ft
Salt and Verde River system (IMPR)	96	94	42	48	2,073,000 ac-ft
NEW MEXICO					
Conchas (FIR)	27	26	26	75	352,600 ac-ft
Elephant Butte and Caballo (FIPR)	9	12	13	29	2,539,000 ac-ft

[a]Thousands of kilowatt-hours (the potential electric power that could be generated by the volume of water in storage).

Provisional data; subject to revision

DISSOLVED SOLIDS AND WATER TEMPERATURES FOR MAY AT DOWNSTREAM SITES ON SIX LARGE RIVERS

Station number	Station name	May data of following calendar years	Stream discharge during month	Dissolved-solids concentration during month[a]		Dissolved-solids discharge during month[a]			Water temperature during month[b]		
			Mean (cfs)	Minimum (mg/L)	Maximum (mg/L)	Mean	Minimum	Maximum	Mean, in °C	Minimum, in °C	Maximum, in °C
						(tons per day)					
	NORTHEAST										
01463500	Delaware River at	1978	20,590	74	123	4,730	2,050	10,830	15.0	12.0	20.0
	Trenton, N.J.	1945–77	14,610	50	115	.....	930	12,500	.....	10.0	28.5
	(Morrisville, Pa.)	(Extreme yr)		(1946)	(1970)		(1965)	(1968)			
			[c]14,300								
04264331	St. Lawrence River at	1978	315,000	167	168	142,000	141,000	145,000	8.5	5.0	11.5
	Cornwall, Ontario, near	1976–77	304,000	165	168	136,000	123,000	153,000	8.5	4.0	11.5
	Massena, N.Y.	(Extreme yr)		(1977)	(1976)		(1977)	(1976)			
	median streamflow at Ogdensburg, N.Y.		[c]257,000								
	SOUTHEAST										
07289000	Mississippi River at	1978	971,900	209	237	564,000	503,000	612,000	18.0	14.5	22.0
	Vicksburg, Miss.	1976–77	501,200	178	232	278,000	176,000	383,000	20.5	17.0	26.0
		(Extreme yr)		(1977)	(1976)		(1977)	(1976)			
			[c]854,600								
	WESTERN GREAT LAKES REGION										
03612500	Ohio River at lock and dam	1978	478,000	175	244	.....	197,000	309,000	.....	15.0	18.5
	53, near Grand Chain, Ill.	1955–77	338,200	156	270	.....	25,500	308,000	.....	6.5	25.0
	(25 miles west of Paducah,	(Extreme yr)		(1976)	(1968)		(1976)	(1961)			
	Ky.; streamflow station		[c]296,500								
	at Metropolis, Ill.)										
	MIDCONTINENT										
06934500	Missouri River at Hermann,	1978	144,000	211	330	103,000	74,700	174,000	17.5	13.0	24.0
	Mo. (60 miles west of St.	1976–77	78,150	263	439	72,000	44,500	121,000	20.0	14.0	24.5
	Louis, Mo.)	(Extreme yr)		(1976)	(1976)		(1977)	(1976)			
			[c]90,880								
	WEST										
14128910	Columbia River at	1978	259,900	88	95	65,000	53,200	73,700	11.5	10.5	12.5
	Warrendale, Oreg.	1976–77	247,000	67	144	63,700	37,500	100,000	12.5	10.5	14.0
	(streamflow station	(Extreme yr)		(1976)	(1977)		(1977)	(1976)			
	at The Dalles, Oreg.)		[c]334,600								

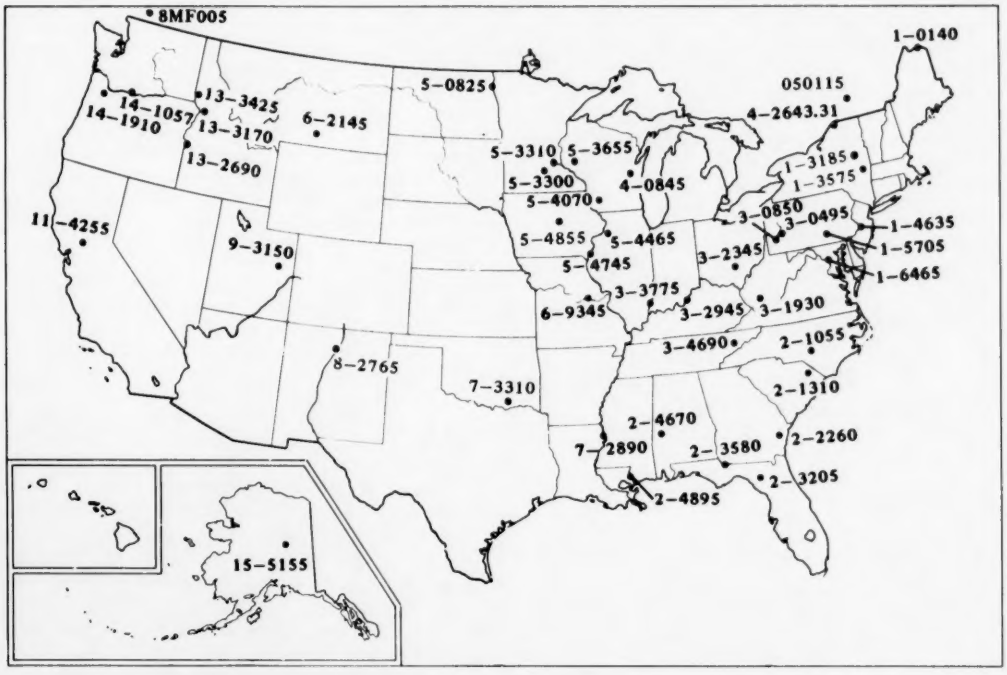
[a] Dissolved-solids concentrations when not analyzed directly, are calculated on basis of measurements of specific conductance.
[b] To convert °C to °F: [(1.8 X °C) + 32] = °F.
[c] Median of monthly values for 30-year reference period, water years 1941–70, for comparison with data for current month.

FLOW OF LARGE RIVERS DURING MAY 1978

Station number*	Stream and place of determination	Drainage area (square miles)	Mean annual discharge through September 1970 (cfs)	May 1978					
				Monthly discharge (cfs)	Percent of median monthly discharge, 1941–70	Change in discharge from previous month (percent)	Discharge near end of month		
							(cfs)	(mgd)	Date
1–0140	St. John River below Fish River at Fort Kent, Maine.	5,690	9,397	46,880	150	+214	10,700	6,920	31
1–3185	Hudson River at Hadley, N.Y	1,664	2,791	7,007	157	-28	2,000	1,290	31
1–3575	Mohawk River at Cohoes, N.Y	3,456	5,450	6,557	107	-59	.....	.....	.....
1–4635	Delaware River at Trenton, N.J	6,780	11,360	20,887	146	-10	29,700	19,200	25
1–5705	Susquehanna River at Harrisburg, Pa.	24,100	33,670	74,060	147	-10	70,000	45,200	25
1–6465	Potomac River near Washington, D.C.	11,560	[1] 10,640	31,390	236	+93	13,900	8,980	31
2–1055	Cape Fear River at William O. Huske Lock near Tarheel, N.C.	4,810	4,847	15,568	494	+95	1,930	1,250	31
2–1310	Pee Dee River at Peedee, S.C	8,830	9,098	20,100	283	+97	7,170	4,630	29
2–2260	Altamaha River at Doctortown, Ga.	13,600	13,380	19,141	159	+59	9,400	6,100	31
2–3205	Suwannee River at Branford, Fla	7,740	6,775	9,420	141	-13	7,710	4,980	31
2–3580	Apalachicola River at Chattahoochee, Fla.	17,200	21,690	38,200	190	+47	15,500	10,000	31
2–4670	Tombigbee River at Demopolis lock and dam near Coatopa, Ala.	15,400	21,700	48,000	305	+329	15,800	10,200	30
2–4895	Pearl River near Bogalusa, La	6,630	8,533	22,620	228	+207	7,390	4,780	30
3–0495	Allegheny River at Natrona, Pa	11,410	[1] 18,700	33,610	140	+368	58,600	37,900	25
3–0850	Monongahela River at Braddock, Pa.	7,337	[1] 11,950	23,340	169	+37	27,700	17,900	25
3–1930	Kanawha River at Kanawha Falls, W.Va.	8,367	12,370	20,950	167	+27	10,500	6,790	23
3–2345	Scioto River at Higby, Ohio	5,131	4,337	6,827	121	-34	8,800	5,690	26
3–2945	Ohio River at Louisville, Ky[2]	91,170	110,600	214,400	159	+31	207,000	134,000	25
3–3775	Wabash River at Mount Carmel, Ill.	28,600	26,310	57,470	166	-17	45,400	29,300	31
3–4690	French Broad River below Douglas Dam, Tenn.	4,543	[1] 6,528	8,643	136	+50	.....	.....	.....
4–0845	Fox River at Rapide Croche Dam, near Wrightstown, Wis.[2]	6,150	4,142	6,885	146	+81	.....	.....	.....
02MC002 (4–2643.31)	St. Lawrence River at Cornwall, Ontario–near Massena, N.Y.[3]	299,000	239,100	314,500	122	+7	313,000	202,000	31
050115	St. Maurice River at Grand Mere, Quebec.	16,300	24,900	94,800	162	+276	22,000	14,000	31
5–0825	Red River of the North at Grand Forks, N. Dak.	30,100	2,439	4,940	109	-84	4,000	2,600	31
5–3300	Minnesota River near Jordan, Minn ..	16,200	3,306	7,290	143	-42	4,730	3,060	25
5–3310	Mississippi River at St. Paul, Minn ...	36,800	[1] 10,230	19,060	89	-46	14,900	9,630	24
5–3655	Chippewa River at Chippewa Falls, Wis.	5,600	5,062	2,502	37	-76	.....	.....	.....
5–4070	Wisconsin River at Muscoda, Wis	10,300	8,457	9,155	86	-34	.....	.....	.....
5–4465	Rock River near Joslin, Ill	9,520	5,288	10,700	171	0	9,200	5,900	31
5–4745	Mississippi River at Keokuk, Iowa ...	119,000	61,210	101,525	116	-28	66,500	43,000	31
5–4855	Des Moines River below Raccoon River at Des Moines, Iowa.	9,879	3,796	4,305	75	-40	3,000	1,900	31
6–2145	Yellowstone River at Billings, Mont.	11,795	6,754	16,130	124	+249	20,000	13,000	31
6–9345	Missouri River at Hermann, Mo	528,200	78,480	142,000	156	-19	147,000	95,000	25
7–2890	Mississippi River at Vicksburg, Miss.[4]	1,144,500	552,700	971,900	114	-13	1,000,000	650,000	31
7–3310	Washita River near Durwood, Okla ..	7,202	1,379	3,140	151	+312	16,000	10,300	31
8–2765	Rio Grande below Taos Junction Bridge, near Taos, N. Mex.	9,730	732	812	71	+173	1,160	750	31
9–3150	Green River at Green River, Utah ...	40,600	6,369	13,577	95	+80	12,500	8,080	31
11–4255	Sacramento River at Verona, Calif ...	21,257	18,370	19,068	98	-43	13,400	8,660	26
13–2690	Snake River at Weiser, Idaho	69,200	17,670	26,150	104	-2	21,400	13,800	29
13–3170	Salmon River at White Bird, Idaho ..	13,550	11,060	30,670	97	+101	33,200	21,500	29
13–3425	Clearwater River at Spalding, Idaho ..	9,570	15,320	30,830	60	+47	35,400	22,900	25
14–1057	Columbia River at The Dalles, Oreg.[5]	237,000	194,000	368,800	94	+57	.....	.....	.....
14–1910	Willamette River at Salem, Oreg	7,280	23,370	19,450	88	+23	13,060	8,440	27–31
15–5155	Tanana River at Nenana, Alaska	25,600	24,040	24,132	68	+183	18,000	11,600	29
8MF005	Fraser River at Hope, British Columbia.	83,800	95,300	135,000	76	+97	146,000	94,400	30

[1] Adjusted.
[2] Records furnished by Corps of Engineers.
[3] Records furnished by Buffalo District, Corps of Engineers, through International St. Lawrence River Board of Control. Discharges shown are considered to be the same as discharge at Ogdensburg, N.Y. when adjusted for storage in Lake St. Lawrence.
[4] Records of daily discharge computed jointly by Corps of Engineers and Geological Survey.
[5] Discharge determined from information furnished by Bureau of Reclamation, Corps of Engineers, and Geological Survey.
*The U.S. station numbers as listed in this table are in a shortened form previously in use, and used here for simplicity of tabular and map presentation. The full, correct number contains 8 digits and no punctuation marks. For example, the correct form for station number 1–3185 is 01318500.

SELECTED STREAM-GAGING STATIONS ON LARGE RIVERS



Location of stream-gaging stations on large rivers listed in table on page 18.

WATER RESOURCES REVIEW

May 1978

Based on reports from the Canadian and U.S. field offices; completed June 9, 1978

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EXPLANATION OF DATA

Cover map shows generalized pattern of streamflow for May based on 20 index stream-gaging stations in Canada and 130 index stations in the United States. Alaska and Hawaii inset maps show streamflow only at the index gaging stations which are located near the points shown by the arrows.

Streamflow for May 1978 is compared with flow for May in the 30-year reference period 1941–70. Streamflow is considered to be *below the normal range* if it is within the range of the low flows that have occurred 25 percent of the time (below the lower quartile) during the reference period. Flow for December is considered to be *above the normal range* if it is within the range of the high flows that have occurred 25 percent of the time (above the upper quartile).

Flow higher than the lower quartile but lower than the upper quartile is described as being *within the normal range.* In the Water Resources Review the median is obtained by ranking the 30 flows of the reference period in their order of magnitude; the highest flow is number 1, the lowest flow is number 30, and the average of the 15th and 16th highest flows is the median.

The normal is an average (but not an arithmetic average) or middle value; half of the time you would expect the May flows to be below the median and half of the time to be above the median. Shorter reference periods are used for the Alaska index stations because of the limited records available.

Statements about *ground-water levels* refer to conditions near the end of May. Water level in each key observation well is compared with average level for the end of May determined from the entire past record for that well or from a 20-year reference period, 1951–70. *Changes in ground-water levels,* unless described otherwise, are from the end of May to the end of June.

The Water Resources Review is published monthly. Special-purpose and summary issues are also published. Issues of the Review are free on application to the Water Resources Review, U.S. Geological Survey, Reston, Virginia 22092.

GROUND-WATER RESOURCES OF CAMBODIA

The accompanying abstract, map (adapted), and cross section are from the report, *Ground-water resources of Cambodia,* by W.C. Rasmussen and G.M. Bradford: U.S. Geological Survey Water-Supply Paper 1608–P, 122 pages. 1977; prepared in cooperation with the Government of Cambodia under the auspices of the United States Agency for International Development. This report may be purchased for $3.75 from the Branch of Distribution, U.S. Geological Survey, 1200 S. Eads St., Arlington, VA 22202 (check or money order payable to U.S. Geological Survey); or from Superintendent of Documents Government Printing Office, Washington, D.C. 20402 (payable to Superintendent of Documents).

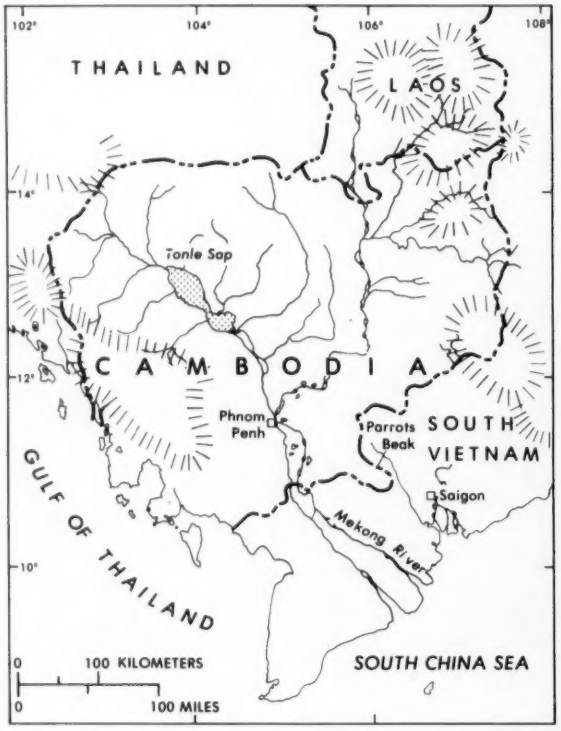

Figure 1.—Map of Cambodia and adjacent countries.

ABSTRACT

Cambodia (now the Khmer Republic), in tropical, humid southeast Asia, has an area of 175,630 km² and a population of about 5 million (fig. 1). The Mekong River, one of the world's largest rivers, flows through Cambodia. Also, the Tonle Sap (Grand Lac), a highly productive fresh-water lake, functions as a huge off-channel storage reservoir for flood flow of the Mekong River. Surface-water discharge in streams and rivers of Cambodia is abundant during the wet season, mid-May through mid-November, when 85 percent of the precipitation falls, but is frequently deficient during the remainder of the year. Annual rainfall ranges from 1,370 mm in the central lowlands to more than 5,000 mm in the mountainous highlands. The mean annual temperature for the country is 27.5°C and the evaporation rate is high.

During 1960–63, 1,103 holes were drilled in 16 of the 18 khets (provinces), of which 795 or approximately 72 percent, were productive wells at rates ranging from 1.1 to 2,967 L/min. The productive wells ranged in depth from 2 to 209.4 m and were 23.2 m deep on the average.

Mr. Rasmussen studied the subsurface geology of Cambodia in considerable detail by examining drillers' logs and constructing nine geologic cross sections (fig. 2). The principal aquifer tapped by drilled wells in Cambodia is the Old Alluvium. In many places, however, dug wells and a few shallow drilled wells obtain water from the Young Alluvium. Sandstone of the Indosinias Formation yields moderate to small quantities of water to wells in a number of places. Also, wells tapping water-bearing basalt have a small to moderate yield.

The quality of water is recorded in only a few analyses. The dissolved-solids concentrations appear to be generally low so that the water is usable for most purposes without treatment. Some well waters, however, are high in iron and would have to be aerated and filtered before use.

In this report, well records are tabulated, and the geology and hydrology is discussed by khets. The bulk of the available information is on the central lowlands and contiguous low plateaus, as the mountainous areas on the west and the higi plateaus on the east are relatively unexplored with respect to their ground-water availability.

No persistent artesian aquifer has been identified nor have any large-potential ground-water sources been found although much of the country yet remains to be explored by test drilling. Well irrigation for garden produce is feasible on a modest scale in many localities throughout Cambodia. It does not seem likely, however, that large-scale irrigation from wells will come about in the future. Ground water may be regarded as a widely available supplemental source to surface water for domestic, small-scale industrial, and irrigation use.

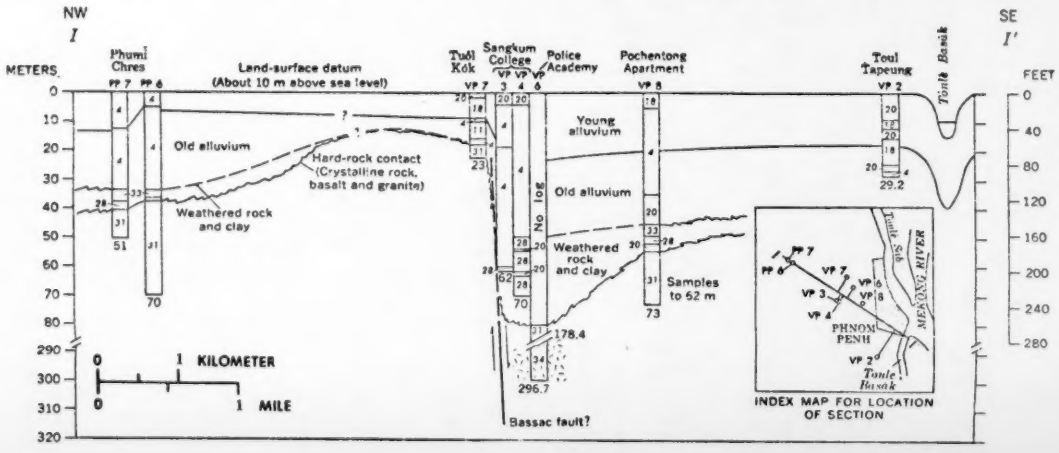

Figure 2.—Cross section I-I' of the Environs of Phnom Penh.

INT: 4066–78